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ABSTRACT

A study was conducted to investigate the respective contributions of personal and social factors (initial competence and imitation of modeled responses) in children's observational learning of conservation. Subjects included 180 first-grade nonconservers from six schools attended by French-speaking middle class pupils. All subjects failed conservation tasks at pretesting; half failed anticipation tasks. Anticipators and nonanticipators were subsequently exposed to one of five pretraining conditions emphasizing (1) generalized imitation of modeled responses different from those suggesting conservation; (2) generalized counter-imitation; or (3) one of three control situations (neutralization pretraining, sensitization period, or no pretraining). Conservation was then demonstrated to all subjects. During the demonstration, one-third of the children were asked to repeat modeled conservation responses after each problem, while an equal number rested during pauses. For the remaining third, no pause interrupted the demonstration. Posttesting was conducted immediately following the demonstration and 4 weeks later. As predicted, performance of anticipators surpassed that of nonanticipators, who showed no progress at all. For anticipators, imitation pretraining provided optimal benefits. Moreover, rehearsal manipulation had no influence on performance. These results were considered in light of a hypothesized sequence of imitation and comprehension processes, the evolution of which is modified by the nonconserver's cognitive preparation and the situational encouragement of imitation. (Author/RH)

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OBSERVATIONAL ACQUISITION OF CONSERVATION AFTER MODELED IMITATION OR COUNTER-IMITATION

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Paper presented within a poster session at the Seventh Biennial Meeting of the International Society for the Study of Behavioral Development, Munich, August 1983.

ABSTRACT

The present experiment investigated the respective contributions of personal and social factors (initial competence and imitation of modeled responses) in the observational learning of conservation. All subjects failed Conservation Tasks at pretesting, half failed and half passed Anticipation Tasks. Anticipators and non-anticipators were subsequently exposed to one of five pretraining conditions which emphasized generalized imitation of modeled responses different from conservation ones, generalized counter-imitation or one of three control situations. Conservation was then demonstrated to all subjects. During the demonstration one-third of the children were asked to repeat modeled conservation responses after each problem, while an equal number rested during pauses. One final third did not benefit from any pause. Posttesting was conducted immediately following demonstration and four weeks later. As predicted, performance of anticipators surpassed that of nonanticipators who showed no progress at all. For the former competent children, imitation pretraining proved to be the only condition to provide optimal benefits. Rehearsal manipulation, moreover, had no influence on performance. These results were discussed with reference to a hypothesized sequence of imitation and comprehension processes, the evolution of which is modified by the nonconserver's cognitive preparation and situation encouragement of imitation.

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Observational Acquisition of Conservation after Modeled Imitation or Counter-Imitation

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In a methodological interface between the observational learning paradigm and a Piagetian assessment of liquid conservation, Charbonneau, Robert, Bourassa, and Gladu-Bissonnette (1976) have shown that brief observation of a model's conserving behavior can lead initial nonconservers to a mastery level which meets the stability criteria establisehd within Piagetian theory.

Closer analysis of the initial data (Charbonneau et al., 1976) reveals a dichotomy in posttests results. While, over time, a good proportion of the new conservers increased their production of adequately justified judgments on problems that differed markedly from those illustrated in training, other childrem either made no progress at all or displayed limited and temporary success. Similar performance dichotomization has been reproduced (Charbonneau & Robert, 1977; Robert & Charbonneau,1979).

Such dichotomization may be accounted for by the nonconservers' engaging properly or not in a hypothesized imitation-comprehension chain of events which receive increasing empirical support (Charbonneau & Robert, 1977; Robert & Charbonneau, 1979, 1980; Robert & Fortin, in press; Robert & Turcotte, in press). Since the observational setting exerts a built-in pressure towards compliance, the nonconserver accepts modeled responses somewhat mimically, given his or her restricted and superficial grasp of their content. Such submissive imitation provokes the proper processing of conservation rule components and the inductive abstraction and deep restructuring behavior which foster true mastery. Hence, differential intellectual predispositions may well be the source of such differential reception of modeled demonstration.

Examination of the content of the standard demonstration (Charbonneau et al., 1976) suggests, however, the need for a more precise identification of the relevant preparatory resources. In the case of each of four problems, the model provides a correct judgement and an acknowledgment of perceptual differences. The judgment is then repeated and the compensation argument supplied. Finally, identity and reversibility arguments for the other problems are added. It would appear that the capacity to initially master the height and width covariation ought to be taken into account because of its close relationship to a modeling input that highlights misleading perceptual disparities and a reconciling compensation argument. Silverman and Rose (1982) consider that this capacity is adequately measured in anticipation tasks where the child is typically asked how high a given quantity of liquid would rise if poured from one container into a wider or a thinner one. Although thesee authors do not consider that compensation necessarily produces conservation, their position may allow covariation as a prerequisite. As opposed to compensation, this capacity implies only that both height and width are considered without necessary synchroneous reciprocal exact variations. Indeed, the precedence of anticipation mastery over that of conservation has been noted in appraisals of spontaneous conservation attainment (Acredolo & Acredolo, 1979; Gladstone, 1981; Leahey, 1977; Piaget & Inhelder, 1966). The same sequencing was observed in cases of induced acquisition, provided, as suggested by Bainerd (1976), that training focused on notions which were connected with anticipation competency (Curcio, Kattef, Levine and Robins, 1972).

On the other hand, the covert imitative practice of modeled conservation, and the ensuing dichotomized performances, may vary in proportion to the spontaneaous and socially-environmentally generated tendency to reproduce the model's behavior. As Steinman (1976) clearly indicated, the built-in pressure and implicit instructions in a social learning situation drive subjects towards compliance. This spontaneous tendency to imitate the model may well be amplified or diminished by manipulation in nonconservation tasks prior to the conversation demonstration.

...3

In the field of operant conditioning, an efficient procedure for establishing the generalized imitation of modeled behavior has indeed been developed. Through the differential reinforcement of the precise topographical reproduction of this behavior, the observer spontaneously adopts other modeled responses the imitation of which has never been reinforced (Baer, Peterson, and Sherman, 1967; Feder & Fouts, 1977; Garcia, Baer and Firestone, 1971; Greenberg, 1979). The reverse procedure has been applied in order to induce generalized counter-imitation: reinforcement is then contingent upon noncompliance to imitation instructions (Oliver, Acker, and Oliver, 1977) or the emission of responses counter to the model's (Sherman, Saunders, and Brigham, 1970).

Another progress agent tied to the imitation-comprehension hypothesis may be the obligation to repeat modeled conservation overtly during the demonstration itself. The impact of rehearsal seems to be modified by the frequency and timing of its occurrence. Indeed, a null effect has been reported when children are invited to reproduce the modeled rule only at the end of modeling (Denny & Turner, 1979). However, a positive effect has been found when children can practice the conservation rule (Murray, Ames, and Botvin, 1977; Rosenthal & Zimmerman, 1972) or another rule (Swanson & Henderson, 1977) during several pauses interspersed within modeling. Moreover, observers who repeated modeled conservation spontaneously during similar pauses were the only ones to achieve true mastery later (Robert & Charbonneau, 1979).

Therefore, with respect to the present modeling session in which compensation plays a central part, it was expected that among nonconservers who first succeeded in an anticipation task, conservation acquisition would surpass that recorded among others who failed the same task.

Following the explanation that ascribes a critical function to imitation in the attainment of conservation comprehension, it is also possible to predict that conservation acquisition should be higher among children trained in the generalized imitation of the model's responses

prior to conservation modeling than among those who have learned to counterimitate the responses systematically. Intermediate acquisition should be found among other children exposed either to control 1 (neutralization) pretraining that balances imitative and counterimitative propensities, to control 2 (sensitization) pretraining that controls interaction with the pretraining setting, or to control 3 (no pretraining at all).

Finally, it may be predicted that acquisition should be higher if, during pauses, nonconservers have to repeat the model's conservation responses. If no rehearsal occurs, learning should be comparable to resulting from uninterrupted modeling since contentless pauses have not been shown to affect conservation attainement (Charbonneau & Robert,1977).

METHOD

Subjects

The final sample consisted of 180 first-grade nonconservers from six schools attended by French-speaking middle-class pupils. These Ss were selected from an initial pool of 260 children. Their ages ranged from 6:0 to 7:5 years with a mean age of 6:7 years.

Materials

The Anticipation and Conservation Tasks required the use of four pitchers containing red liquid, coffee, milk, and water respectively; 30 metal beads; one L-shaped glass tube (13 x 13 x 1.3 cm in diameter); one cognac glass; four sealed-top bottles, two trapezoidal and two cylindrical (with narrow necks), each partly filled with 120 cc of red liquid; and one stand divided into five sections with respective heights

of 7.5, 2, 4.5, 10.0 and 2.5 cm; and 10 cc of sand; a set of 19 translucent plexiglass beakers as follow: three 15 cm high (3.2 cm in diameter) standard beakers, S_1, S_2, and S_3; one 4 cm high beaker, J (the letter refers to the order in which the beakers were used), the top side of which was in the shape of a doughnut (a beaker 4.5 cm in diameter having been glued within another beaker 8.2 cm in diameter); four 5 cm high beakers (2.0 cm in diameter), E_1 through E_4; two 10 cm high beakers (respectively 7.0 and 7.7 cm in diameter, I and D: one 15 cm high beaker (1.5 in diameter), C; three 15 cm high beakers (2.0 cm in diameter), A' (vertically divided into 15 equally spaced and marked units), A_1 and A_2; two 15 cm high beakers (4.5 cm in diameter), B' (vertically divided into 15 equally spaced and marked units) and B; and three 23 cm beakers (respectively 2.0, 3.2, and 4.5 cm in diameter), G, F, and H.

For the pretraining tasks, the materials were a television set, a programmed system for slide projection contained in a box on one side of which a screen (32 X 32 cm) was mounted, a keyboard (with two push buttons) located under the screen, 40 color slides, a tray with 80 plastic chips and a variety of trinkets.

During the model's (M) conservation demonstration, a videotape recorder was used.

Procedure

During each of the three to six sessions (according to the various experimental conditions) each S was alone with E. Each session required 35 min., except Session 5 completed in 7 min. Session 1 with Ea (female aged 25) was devoted to pretesting with Conservation-related and Conservation Tasks. During Sessions 2 and 3 for which Eb(same characteristics as Ea) was responsible, pretraining conditions were establised.

...6

Session 4 involved conservation training through observational learning, with manipulation of rehearsal (Eb) and immediate posttesting (Ea). During Session 5 (Eb) pretraining stability was checked. Each of the preceding sessions was conducted on five successive days. Finally, four weeks later, a follow-up was completed in Session 6 (Ea) .

Pretest (Session 1)

Ea brought S from his/her classroom to room A.

In an Anticipation Task, S_1 containing 40 cc of red liquid was placed successively beside A' and B'. S had to point to the level the liquid contained in S_1 would reach if poured into A', then into B', and to justify his or her answer. S was called an anticipator if in both problems, he or she predicted a height change of at least 1 cm in the right direction and produced a compensation argument. He or she was called a nonanticipator if he or she predicted no height change or a change of less than 1 cm. All other answers were associated with partial success and led to the rejection of 22 children.

The child then performed 10 Conservation Tasks (liquid and discontinuous quantity). Task 1: Once he or she had agreed that S_1 and S_2 contained an equal quantity (30cc) of red liquid, the experimenter poured the contents of S_2 successively into A_1, B (after a return to S_2), C, and D. Task 2: S_1 and S_2 each containing 12 beads, the contents of S_2 were poured into A_1 and B. Task 3: S_1 and S_2 each containing 30 cc of liquid, the contents of S_2 were poured into the L-shaped tube and the cognac glass. Task 4: After each problem from Task 3, Ea asked the child to turn around, holding hands over ears, withdraw some liquid or leave the contents unmodified. Ea actually added some liquid to the tube and withdrew some from the glass. The child had to look at S_2 and the tube or the glass and to decide what had been done. In problem 2, Ea offered him or her four choices: placing S_2 and the glass side by side and comparing the height

...7

of the liquid in each; returning the contents of the glass into S_1; placing the glass in front of S_2 and comparing the width of the liquid in each; finally, holding the glass and S_2 and comparing their weight. Task 5: Ea used the two trapezoidal bottles, turning one of them upside down; next, one of the two cylindrical bottles was placed on its side. Task 6: S_1 and S_2 each contained 30 cc; the contents of S_2 were partitioned equally into A_1 and A_2, to be compared simultaneously with S_1; the liquid in A_2 was partitioned equally among E_1, E_2, E_3 and E_4, to be compared with A_1; finally all of A_1, E_1, E_2, E_3, and E_4 had to be compared with S_1. Task 7: S_1 and S_2 contained respectively 30 and 60 cc; the contents of S_2 were poured into D and F. Task 8: B contained 40 cc and the child had to pour the same amount into A_1 and D. Task 9: After the G, F, B, A_1, and H beakers were filled up to heights of 19.5, 19.5, 7.0, 9.7 and 13.4 cm respectively the child chose the beaker containing the least amount, then the next one, and so on, until only one beaker was left: the child explained how he or she had managed to know that one of the beakers indicated by Ea contained more than the other. S had to produce the reverse ranking and the same justifications when presented with the stand displaying D, G, A_1, H, and F which were filled up to heights of 7, 15, 14, 11, and 21 cm respectively. Task 10: S_1 and S_2 each contained 30 cc of water and the contents of S_1 were poured into I which already contained sand up to a 2 cm height. Then, S_1 and S_2 each contained 30 cc of milk and the contents of S_2 were poured into the 40 cc of coffee which J already contained in the space between the larger and the smaller beaker of which it was made. For each problem respectively, the child was asked if S_1 and I contained the same amount of water and S_1 and J the same amount of milk.

For each task, a score of 1 or 3 was attributed respectively when in every problem the S never produced or always produced both a conservation judgement and an adequate justification. A score of 2 was associated with success (correct judgment and justification) on at least one problem. Consequently, the global individual score ranged between

...8

10 and 30. In tasks 1, 2, 3, 5, 6, and 7, any of the identity, compensation, or reversibility arguments were adequate justifications. In task 4, only reversibility was accepted provided that equality judgments had been supplied in Task 3. In tasks 8 and 9, only compensation was correct while in Task 10 only identity was correct. Consequently, a total of 180 nonconservers who had obtained a global score of 10 (135) or 11 (45) participated in the following sessions. They included 45 male and 45 female anticipators and 45 male and 45 female nonanticipators. Having reached a global score of 12 or more, 52 other children were eliminated.

Pretraining (Sessions 2 and 3)

With boys and girls in equal number, 18 anticipators and 18 nonanticipators were respectively exposed twice (during sessions 2 and 3) to one of five pretraining conditions. Eb brought the child to room B. Sitting side by side, they faced the television set, the slide projector, the videotape camera and the chips tray. The videotape recorder was located behind the table. Trinkets were displayed on a nearby table.

Picture task. The Picture Task involved 40 items (pairs of objects, animals or people) each presented on a different slide. Eb said to the child: "I will show you a gentleman on the television, who did and said things. Watch him and listen carefully. He had a machine like this one (Eb pointed to the slide projector). Each time I showed him two pictures, he pressed the button under the picture he liked best and the button lit up. He also said why he preferred this picture to the other one. After the gentleman has made his choice, pressed one button, and given the reason of his choice, I will ask you the same question and you will be allowed to say the same thing or not the same thing as the gentleman said."

For each item, M (male aged 30) on videotape, operated one of two push buttons and justified his choice. For example, Eb asked: "Which of

...9

these two people, a fireman and a policeman, do you choose and why do you choose this person?"; M answered: "Even though the fireman extinguishes fires, I choose the policeman because he prevents accidents". Or Eb asked: "Which of these two vegetables, a cucumber and a tomato, do you choose and why do you choose this vegetable?"; M answered: "Even though the cucumber is crunchy, I choose the tomato because it is juicy". For half the items (in random order identical for all subjects), M choose the picture presented in the right part of the slide. After each modeled item, S was allowed 10 sec. to choose a picture from the same choice. First, the choice was scored as an imitation response if the child selected the picture chosen by M; selection of the other picture was considered a counterimitation response. Second, the justification was scored as imitative when the child repeated M's justification using the same words or words with the same meaning; a justification was counterimitative when S either used M's justification but reversed it in order to base an opposite choice, or generated an original justification. Each item presentation was separated by 3 to 5 sec.

During session 2, the first six items served as a base level recording; the initial tendency to imitate or counterimitate was then assessed. No reinforcers were distributed.

During the remaining items for session 2 and during all the items during session 3, 36 children were exposed to generalized imitation pretraining. Eb said to S : "From now on, the game is for you to press the same button he pressed and to say the same thing he said (Eb gave an exemple of imitation -choice and justification - response). You will receive a chip if you say the same thing he said. But some times you will not receive a chip even if you say the same thing he said. At the end, you will be allowed to trade your chips for one of the toys that you see over there (Eb pointed to the trinkets). You will not receive a chip if you don't press the button the gentleman pressed or if you don't say the same thing he said. Don't forget that you must have enough chips to get a gift." Each time the child copied the modeled choice, he or she was praised and

...10

given a chip; the same consequences ensued when M's justification was supplied. If a nonmodeled choice or justification was produced, Eb removed the involved slide and paid no attention to the child for 5 sec. After this period of extinction for counter-imitation, the same trial was repeated. For trials, 10, 14, 18, 22, 27, 32, 36, and 40, the fixed ratio reinforcement contingency was not applied; this permitted imitation generalization assessment. During session 2, the Task was completed when, during 11 successive items, the child performed 16 (8 choices and 8 justifications) reinforced imitation responses and 6 (3 choices and 3 justifications) nonreinforced ones. During session 3, the criteria involved (on 14 successive items) the emission of 20 reinforced imitation responses and of 8 nonreinforced imitation responses.

Thirty-six children were exposed to generalized counter-imitation pretraining. The instruction format was as in the preceding condition but the content stressed the requirement of pressing the button which M had not selected and of supplying a different justification. For each of sessions 2 and 3 respectively, the procedure and completion criteria were also identical except that they applied to counterimitation responses.

Thirty-six children were exposed to a control 1 condition (neutralization pretraining) the purpose of which was to cancel the imitation or counterimitation tendency that might have been part of the Ss repertory or might be induced by the observational setting itself (Steinman, 1976). The instruction format was the same as in the first condition, but the content stressed the fact that for some items S had to press the same buttton as M and to supply the same justification and that for other items he or she had to press the other button and to supply a different justification. For each half of the items (in random order identical for all Ss), imitation and counterimitation responses were respectively reinforced. The rest of the procedure was as in the first condition. For each of the two training sessions, the task was completed when no more than 60% of the responses emitted respectively on 9

and 12 successive trials were of only the imitation or counterimitation type.

Thirty-six children were exposed to a control 2 condition (sensitization period) aimed at controlling contact with E, M, and the pretraining setting and reception of reinforcers. The child was told that, after each of the M's justifications for a picture choice, he or she would be shown two new pictures and allowed to choose either of the pictures for any reason he or she had. Whatever their content, each of the child's choices and justifications were praised and he or she was given one chip. Control 2 condition was completed in 20 min. during session 2 and five minutes later during session 3 (typical duration of any of the three above mentionned pretraining conditions).

Thirty-six children were not exposed to any pretraining. Control 3 subjects completed Sessions 4 and 6, after which they were given trinkets.

Question Task. For each of the two sessions, 40 items of the Question Task followed the completion of the Picture Task. All Ss received the following instructions: "Now the gentleman on television will answer some questions. Listen carefully to what he says. After each of his answers, I will ask you the same question and you will then be allowed to reply the same thing or not the same thing."

M never favored either of the two choices and supplied a justification that emphasized the equal attractiveness of both. The format of his statements was identical to that of his equality conservation responses to appear in Session 4. For example, Eb asked: "Which fruit do you prefer to eat, an orange or an apple, and why?" or "Do you prefer winter or summer, and why?" and M replied respectively: "I like them both equally because oranges are juicy and apples are sweet" and "I like one as much as the other because in the wintertime I go skating and in the summertime I go swimming." The child's answer was scored as imitative if it expressed no preference; so was the justification if formally or

semantically similar to the modeled one. A preference choice and a dissimilar justification were both scored as counterimitative.

During the first six trials of session 2 only, the base level of initial imitation and counterimitation tendencies was established.

The child undergoing generalized imitation pretraining was then told "From now on, when the gentleman has answered one question, I will ask you the same question and the game is for you to repeat his answer and his reason (E5 gave an example of an imitation -answer and justification -response). You will receive a chip if you give his answer and another chip if you repeat his reason, but sometimes you won't get a chip even if you say the same thing he said. You have ro repeat all of the gentleman's response. You won't get a chip if you don't say the same thing as the gentleman. Don't forget that you must have enough chips to get a gift." Praise and chip dispensing followed each answer of nonpreference and each copied justification. In this condition as well as in the two subsequent ones, extinction periods and generalization trials were performed as during the Picture Task; for each session the same completion criterion was applied.

For the child undergoing generalized counterimitation pretraining, the instruction format was as in the preceding condition but the content stressed the requirement of making a preference choice and of supplying another justification than M's.

For the child undergoing the control 1 condition, half of M's statemens had a format similar to that involved in the Picture Task. For example, when asked "Which do you like better, Christmas Day or the day of your birthday, and why?", the model answered "Although I receive presents on my birthday, I like Christmas Day better because every one receives a present at Christmas." This format prevented the occurrence of a close similarity between M's and S's statements that might give too narrow an orientation to the latter's forthcoming conservation responses. The instruction format was as in the first condition but the content stressed the fact that, for some items, the child had to provide the same nonpreference answer and the same justification as M and that,

for other items, he/she had to supply a preference choice and a different justification. The reinforcement contingency applied to half of both the imitation and counterimitation responses.

For the child undergoing a control 2 condition, M's answers followed the format involved in the preceding condition. The child was told that, after each of M's justification, he or she would be asked a new question and allowed to choose any of the involved elements for any reason he/she had. Praise and chip dispensing were conducted as during the Picture Task. The period lasted 15 min. during session 2 and 20 min. during session 3 (typical duration of any of the above-mentioned pretraining conditions).

Finally, the chips were exchanged for a trinket of the child's choice.

Observational Learning of Conservation and Verbal Activity (Session 4, Part 1)

All Ss were exposed to conservation modeling in room B. S was told to watch carefully because he/she would be shown a man on television who would go through some of the tasks which he/she had performed during the pretest. No reference was made to any of the posttests. On videotape M gave correct conservation judgments for all four problems of Task 1 for approximately 5 min. Each of these judgments was accompanied by an acknowledgement of perceptual differences followed by the statement of compensation argument. Finally the judgments were also supported alternately by identity or reversibility justifications.

For one third of the anticipators and of the nonanticipators (equal in number for the five pretraining conditions), modeling was interrupted for 30 sec. after each demonstrated problem. The child then had to perform an overt rehearsal of the modeled judgment and justifica-

tions that had to be as accurate as possible. For one third of the anticipators and of the nonanticipators, 30 sec. silent pauses also occurred after each problem but they were presented as rest periods. For the other anticipators and nonanticipators, no pause interrupted the demonstration.

During M's demonstration, all children's behavior was videorecorded to allow assessment of eye contact with the television screen and of lip movements. These two measurements were considered indicators of visual attention (Piontkowski & Calfee, 1979), and spontaneous verbal-mediational activity (Flavell, 1970).

Posttest (Session 4, Part 2)

During the posttest, the procedure was the same as during the pretest. The same scoring technique used in the pretest was applied to posttest conservation performance.

Stability check (Session 5)

In order to determine whether the responses established during Sessions 2 and 3 were maintained, Session 5 involved a new recording (in room B) of each child's base level for the six first items of each of the Picture and Question Tasks. This recording followed the procedure previously described in relation to each of the four pretraining conditions respectively.

Follow-up (Session 6)

During the follow-up, the procedure was the same as during the posttest. In order to check for possible complying nonconservation responses among Ss who had been pretrained to counterimitate M, a supplementary task was performed by the 18 Ss who had obtained a global score of less than 15 and a score of 1 or 2 in Tasks 1, 2, and 3.

...15

Countersuggestions were made after Ea had repeated each problem from these tasks. She reminded S that he/she had said that one beaker contained more and stated the child's justification. Ea added that another child had later said to her that both beakers contained the same amount and had stated all three compensation, identity, and reversibility arguments. She asked the child to compare the beakers once again and to justify his or her judgment.

RESULTS

The results illustrated pretraining performance, conservation scores, and some additional features.

Pretraining Performances

Table 1 reports the mean number (combined for Picture and Question Tasks) of imitation and counterimitation responses and the standard deviation obtained for each level of competency and each type of pretraining during each (Sessions 2 and 5) base level recording and during pretraining itself. For each base level recording, the imitation and counterimitation data were analyzed separately in a 2 (competency) X 4 (pretraining) factorial design. For pretraining, a main effect for type of pretraining was measured for both imitation (F (2,102) = 1978.95, $p < .001$) and counterimitation (F (2,102) = (2555.44, $p < .001$) responses. Post hoc comparisons were made ($p < .01$) with the Newman-Keuls method: more imitation responses were emitted in the imitation condition than in control 1; more imitation responses were also produced in control 1 condition than in counterimitation. The reverse ranking was obtained with the number of counterimitation responses. The same pattern was observed during final base level recording with imitation (F (2,102) = 70.26, $p < .001$) and counterimitation (F (2,102) = 70.28, $p < .001$) responses. Post hoc comparisons disclosed that more imitation responses were produced in the imitation condition than in control 1 and 2 conditions; more imitation was also recorded in these latter conditions than in counterimitation; and control 2 condition

generated more imitation than control 1.

Insert table 1 about here

Conservation Scores

Table 2 includes the mean global score and standard deviation obtained, during the pretest, posttest and follow-up, by nonanticipators and anticipators in each pretraining and rehearsal condition. Posttest and follow-up data were first analyzed so as to determine any progress since the pretest. As indicated in Table 2, a series of *t* tests revealed that among the 15 nonanticipator groups, progress was virtually nonexistent, since it was restricted to three isolated groups (who had been exposed to imitation pretraining followed by rest pauses, or to no pause at all during conservation demonstration, or to control 2 condition followed by a pauseless demonstration). An almost converse pattern emerged from the anticipators' superior achievement, progress being present in all but one (who had completed control 2 condition followed by a pauseless demonstration) of the 15 groups. Mostly because of the inconsistency underlying the learning verdict in the latter two control groups, the results for all four cases were best attributable to experimental error. It was thus concluded that acquisition was respectively absent and present among the nonanticipator and the anticipator groups.

The posttest and follow-up scores were then analyzed in a 2 (competency) X 5 (pretraining) X 3(rehearsal) X 2 (repeated measure) factorial design. As expected, the anticipators surpassed the nonanticipators ($F(1,150) = 19.9$, $p < .001$). An interaction between the competency, pretraining, and repeated measure factors was also obtained ($F(4,150) = 2,50$, $p < .05$). Analysis of this interaction indicated that from posttest to follow-up, scores increased in the anticipator groups who received imitation pretraining ($F(1,150) = 13.19$, $p < .001$), whereas they were stable among all other groups.

Insert table 2 about here

Therefore, the absence of acquisition among nonanticipators did not allow for registration of a differential impact of the pretraining and rehearsal activity variables among them as predicted by the last two hypotheses. Among the anticipators, however, the second prediction was partially confirmed. Indeed, imitation pretraining generated more learning than the three control conditions which yielded equivalent acquisition. However, counterimitation pretraining was not found to lead to lower achievement than any of the latter conditions. The third prediction was not supported: the type of verbal activity during conservation demonstration had no effect.

Additionnal measures

The mean duration of eye contact (interrater agreement: r = .98) and the mean number of lip movements (interrater agreement: r = .97) produced during conservation demonstration by nonanticipators and anticipators in each pretraining and rehearsal condition are reported in table 3. The standard deviation is also included. This data was analyzed separately in a 2 (competency) X 5(pretraining) X 3 (rehearsal) factorial design. For eye contact, a main effect of pretraining was obtained ($F(4,150) = 2,89$, $p < .05$). Post hoc comparisons disclosed that the groups who completed the control 2 period (during which their responses had simply alternated with M's) maintained less ($p < .05$) eye contact than the other groups for whom reinforcement had been contingent upon adjusting their responses (in different ways) to M's . However, such a difference had no bearing on the conservation score either in posttest (r = .06) or in follow-up (r = .08). For lip movements, a main effect of rehearsal was obtained ($F(2,150) = 10.60$, $p < .001$). Post hoc comparisons revealed that while M was demonstrating conservation, the groups who had to repeat his responses overtly during later pauses, produced more ($p < .05$) lip movements than the groups who were allowed rest pauses or no pause at all.Again the recorded difference was not related to conservation scores on post-

test (r = .08) and follow-up (r = .09) .

Insert table 3 about here

A classification in one of two categories of the responses produced by those Ss who had to repeat modeled conservation overtly during appropriate pauses was established by two judges. The first category consisted of equality responses supplemented by an adequate justification. The second consisted of unjustified equality responses, inequality responses, correct justifications alone and absent responses. A S's total production was put in one category if, for three out of four pauses, his or her responses belonged to this category. Due to technical recording difficulties, responses from six children had to be discarded. Fourteen nonanticipators and 22 anticipators belonged to the first category, and 12 nonanticipators and 6 anticipators to the second one. However, the tendency for anticipators to be more successful in repeating the model's responses proved less than significant (χ^2 (1) = 2.68, p <.06, one-tailed). Posttest and follow-up scores ranging between 10 and 15, 16 and 20, 21 and 25, and 26 and 30 were put into different classes. A positive relationship (contingency coefficient) was found between emission of appropriate rehearsal during observation and later attainment of high scores. Such a relationship existed with respect to rehearsal on problem 1 and scores on follow-up (C (3) = .36, p <.05) and rehearsal on problem 2 and scores on posttest and follow-up respectively (C (3) = .43, p < .01) and a (C (3) = .44, p <.01) .

Sixteen of the subjects involved maintained their nonconservation judgments and justifications in the face of Ea's countersuggestions at the end of follow-up. The other two maintained the same judgments without justifying them.

DISCUSSION

The useful portion of modeled information appears to be undoubtedly dependent upon the degree to which the observer can construct the conservation notion when exposed to applications of the conservation rule. Indeed, the superiority of anticipators was overwhelmingly confirmed through exclusive association of initial understanding of covariation with a learning verdict. These results strongly support the conclusions offered by Curcio et al. (1972) and Leahey (1977), according to whom the mastery of anticipation is accompanied by the definition of functional relationships between the height and width dimensions. However, as Brainerd (1976) has urged, identification of relevant cognitive resources relies on a precise examination of the connection between one specific competency and the content of the training method. In the present case, compensation was given a crucial role in terms of serial position (Robert & Turcotte, in press) and of quantitative importance in the model's statements. Thus, preliminary assessment of anticipation was appropriate. It is nonetheless very likely that the anticipators differed from the nonanticipators with respect to other preparation variables that also correlate with learning (Robert & Fortin, in press; Robert & Lacroix, in press) or which still have to be isolated. Apart from conservation scores, other evidence substantiated the nonanticipators' less mature behavior. Rehearsal data recorded during conservation modeling showed that these children tended to be unable to perform adequate repetitions of modeled answers and to substitute responses for those answers that were more in tune with their own primitive functioning.

The hypothesis of interrelated imitation and comprehension processes (Robert & Charbonneau, 1979; Robert & Fortin, in press) accounts for the present acquisition dichotomy. It may be that since nonanticipators are cognitively unreceptive to the modeled rule as a whole, they were not tempted to use it mimically, either in a covert or an overt fachion. Consequently, they never achieved proper understanding.

By contrast, anticipators, with their more complete cognitive

...20

equipment, started rule practicing more readily. Gaining some comprehension through this application of the correct solution, they became more convinced of its adequacy from posttest to follow-up, used it extensively, and deepened their understanding of its components. Indeed, Robert and Lacroix (in press) have reported that preparatory training aimed at discouraging the nonconserver from considering only the height dimension, increased the impact of modeling, probably because it enabled the child to process modeled information with more competency. As Kuhn (1973) has advocated, competent children are strongly motivated to reproduce this information since their cognitive resources are compatible with it. Uzgiris' (1981) conception of the two additive functions of imitation may also be relevant in this context: imitative activity may promote mutual communication between the model and the child observer; the desired relationship is then determined mostly by social and affective variables. Imitation may serve a more informational purpose: this effect is linked mostly with cognitive parameters. In the case of presently less-advanced nonconservers, it is likely that pretraining allowed some imitation with a social function; on the other hand, deficient intellectual support later led to very little imitation with a cognitive function. Both types of imitation underlay the evolution of anticipators. Their cognitive attraction for modeled content encouraged the proper process sequencing, with fading of imitation (under the control of social factors) and parallel abstraction of the conservation rule through transfer of control. In line with the imitation–comprehension explanation, it could be that imitation of conservation is established more rapidly and extensively when reproduction of modeled answers has met approval, materially and socially, than when pretraining has not been directed towards generalized imitation. However, the comprehension level resulting from such accelerated imitation is probably not refined and discriminate enough to encourage achievement of superior scores on immediate posttesting. Imitation nevertheless leads to better delayed understanding because it is continued, to some extend, during immediate posttesting itself, as shown by Robert and Fortin (in press).

The recording of equivalent conservation scores in control conditions and in the counterimitation condition cannot be ascribed to failure to develop a counterimitative habit among subjects from the counterimitation condition. Nevertheless benefits from conservation demonstration did not diminish, because of strong compatibility between anticipators' high degree of preparation and modeled cogent problem solving. In spite of their counterimitative propensity, these advanced children had the autonomous capacity to judge the intrinsic adequacy of the modeled rule. Consequently, they bypassed their opposition habit in matters with no objectively correct answers and processed the demonstration content as did the subjects for whom no specific tendency had been shaped.

With respect to the last prediction, acquisition was unaffected by rehearsal manipulation, even though the frequency and timing of rehearsal ought to have been favorable (Murray et al., 1977; Rosenthal & Zimmerman, 1972; Swanson & Henderson, 1977). The cause of such a null effect may have been instructions that required the children to focus too narrowly on the formal aspects of modeled responses and insufficiently on their meaning. As Rosenthal and Zimmerman (1978) indicate, instructions content may have diverted the children's attention towards the lexical and syntaxical elements. In addition, as Robert & Gaudreault (1982) have concluded from similar results, supplying visual support (the televised image of the transformed quantities) to verbal rehearsal may be helpful because the sole rote learning capacity is less sollicited. However, examination of rehearsal responses provided some indication that the early capacity (during observation itself) to reproduce correctly modeled conservation was connected with later achievement. The same correlation had been noted by Robert and Charbonneau (1977) among children whose imitation was spontaneous.

In conclusion, the present results indicate the power of the personal and social-environmental factors that foster observational acquisition of conservation, and the probable course of events (imitation-comprehension) through which such acquisition is established.

REFERENCES

Acredolo, C., & Acredolo, L.P. Identity, Compensation and Conservation. Child Development, 1979, 50, 524-535.

Baer, D.M., Peterson, R.J., & Sherman, J.A. The Development of Imitation by Reinforcing Behavioral Similarity to a Model. Journal of the Experimental Analysis of Behavior, 1967, 10, 405-416.

Brainerd, C.J., Does Prior Knowledge of the Compensation Rule Increase Susceptivility to Conservation Training? Developmental Psychology, 1976, 12, 1-5.

Charbonneau, C., & Robert, M. Observational Learning of Quantity Conservation in Relation to the Degree of Cognitive Conflict. Psychological Reports, 1977, 41, 875-986.

Charbonneau, C., Robert, M., Bourassa, G., & Gladu-Bissonnette, S. Observational Learning of Quantity Conservation and Piagetian Generalization Tasks. Developmental Psychology, 1976, 12, 211-217.

Curcio, F., Kattef, E., Levine, D. & Robbins, O. Compensation and Susceptibility to Conservation Training. Developmental Psychology, 1972, 1, 259-265.

Denny, N.W., & Turner, M.C. Facilitating Cognitive Performance in Children: a Comparison of Strategy Modeling and Strategy Modeling with overt Self-verbalisation. Journal of Experimental Child Psychology, 1979, 28, 119-131.

Feder, J., & Fouts, G. Effect of Similarity Training on Imitation. Perceptual and Motor Skills, 1977, 45, 571-578.

Flavell, J.H. Developmental Studies of Mediated Memory. In H.W. Reese & L.P. Lipsitt (Eds), Advances in Child Development and Behavior, vol. 5. New York: Academic Press, 1970.

Garcia, E.E., Baer, D.M., & Firestone, I. The Development of Generalized Imitation within Topographically Determined Boundaries. Journal of Applied Behavior Analysis, 1971, 4, 101-112.

Gladstone, R. Conservation and Compensation. Journal of Genetic Psychology, 1981, 138, 193-205.

Greenberg, S. The Effects of Differential Reinforcement of Generalized Imitation. Journal of Experimental Child Psychology, 1979, 27, 223-249.

Inhelder, B., Sinclair,H., & Bovet, M. Apprentissage et structures de la connaissance. Paris: Presses Universitaires de France, 1974.

Kuhn, D. Imitation Theory and Research from a Cognitive Perspective. Human Development, 1973, 16, 157-180.

Leahey, T.H. The Development of Conservation Abilities: an Intertask Analysis of Continuous Quantity. Merrill-Palmer Quarterly of Behavior and Development, 1977, 23, 215-225.

Murray, F.B., Ames, G.J., & Botvin, G.J. Acquisition of Conservation through Cognitive Dissonance. Journal of Educational Psychology. 1977, 69, 519-527.

Oliver, O.R., Acker, L.E. & Oliver, D.O. Effects of Reinforcement Histories of Compliance and Noncompliance on Nonreinforced Imitation. Journal of Experimental Child Psychology, 1977, 23, 180-190.

Piaget, J., & Inhelder, B. L'image mentale chez l'enfant. Paris: Presses universitaires de France, 1966.

Piontkowski, D. & Calfee, R. Attention in Classroom. In G.A. Hale & M.Levis (Eds), Attention and Cognitive Development. New York: Plenum Press, 1979.

Robert, M., & Charbonneau, C. Effet de l'énoncé d'un problème d'inégalité sur l'acquisition de la conservation par observation. L'Année psychologique, 1979, 79, 393-409.

Robert, M., & Charbonneau, C. Apprentissage de la conservation en fonction de l'argument du modèle. L'Année psychologique, 1980, 80, 411-431.

Robert, M., & Fortin, A. Observational Learning of Conservation: When Practive Makes Nearly Perfect. British Journal of Developmental Psychology, in press.

Robert, M., & Gaudreault, J.M. Conservation Learning and the Differential Impact of Visual Information Available during and after Modeling. Acta Psychologica. 1982, 51, 123-135.

Robert, M., & Lacroix, P.E. Apprentissage de la conservation par observation: compétences repérées et provoquées chez l'enfant. Psychologie française, in press.

Robert, M., & Turcotte, P. Position sérielle des arguments du modèle et apprentissage de la conservation par observation. L'Année psychologique, in press.

Rosenthal, T.L., & Zimmerman, B.J. Modeling by Exemplification and Instruction in Training Conservation. Developmental Psychology, 1972, 6 , 392-401.

Rosenthal, T.L. & Zimmerman, B.J. Social Learning and Cognition. New York: Academic Press, 1978.

Sherman, J.A., Saunders, R.R., & Brigham, T.A. Transfer of Matching and Mismatching Behavior in Preschool Children. Journal of Experimental Child Psychology, 1970, 9, 489-498.

Silverman, I.W. & Rose, A.P. Compensation and Conservation. Psychological Bulletin, 1982, 91, 80-101.

Steinman, W.M. Implicit Instructions and Social Influence in "Generalized Imitation" and Comparable Nonimitative Situations. Merrill-Palmer Quarterly of Behavior and Development, 1976, 22, 85-92.

Swanson, R.A., & Henderson, R.W. Effects of Televised Modeling and Active Participation on Rule-Governed Question Production among Native American Preschool Children. Contemporary Educational Psychology, 1977, 2, 345-352.

Uzgiris, I.C., Two Functions of Imitation during Infancy. International Journal of Behavioral Development, 1981, 4, 1-12.

... 26

Table 1

Mean Number of Imitation and Counterimitation Responses and Standard Deviation for Each Level of Initial Competency and Each Pretraining Condition during Base Level$_1$ (Session 2), Pretraining (Sessions 2 and 3), and Base Level $_2$ (Session 5)

Initial Competency	Pretraining	Base Level$_1$		Pretraining		Base Level$_2$	
		M	SD	M	SD	M	SD
		Imitation Responses					
	Imitation	7.33	4.27	107.50	12.94	16.06	5.43
	Counterimitation	7.00	4.99	0.94	1.11	2.44	2.12
Nonanticipators	Control 1	7.28	3.49	47.39	5.35	11.22	3.26
	Control 2	6.78	2.02	--	--	7.50	2.59
	Imitation	6.44	4.39	98.22	6.46	15.56	6.43
	Counterimitation	5.67	3.38	0.94	2.41	3.67	1.91
Anticipators	Control 1	7.78	3.32	46.28	6.95	10.94	3.84
	Control 2	6.39	2.81	--	--	7.78	2.69
		Counterimitation Responses					
	Imitation	16.67	4.27	3.78	2.73	7.94	5.43
	Counterimitation	17.00	4.99	104.39	9.44	21.56	2.12
Nonanticipators	Control 1	16.72	3.49	49.61	5.27	12.78	3.26
	Control 2	17.22	2.02	---	---	16.50	2.59
	Imitation	17.56	4.39	2.67	1.97	8.44	6.43
	Counterimitation	18.33	3.38	98.22	7.37	20.33	1.91
Anticipators	Control 1	16.22	3.32	44.72	4.64	13.61	3.79
	Control 2	17.61	2.81	---	---	16.22	2.69

Table 2

Mean Global Score (Minimum: 10, Maximum: 30) and Standard Deviation for each Pretraining and Rehearsal Condition and for Each Level of Initial Competency on Pretest and on Posttest and Follow-up

Pretraining	Rehearsal	Pretest		Posttest		Follow-up	
		M	SD	M	SD	M	SD
Nonanticipators							
Imitation	Rehearsal	10.00	0.00	15.50	8.28	15.67	8.21
	Pause	10.00	0.00	18.67*[a]	6.74	19.00*	7.74
	No pause	10.00	0.00	20.50*	8.28	20.00*	7.87
Counter imitation	Rehearsal	10.00	0.00	11.50	3.20	12.50	4.32
	Pause	10.00	0.00	12.00	4.42	12.83	5.23
	No pause	10.00	0.00	14.83	5.11	15.00	5.79
Control 1	Rehearsal	10.33	0.51	17.67	8.06	18.67	7.73
	Pause	10.17	0.40	16.67	7.58	16.67	7.63
	No pause	10.00	0.00	17.00	8.00	16.83	7.90
Control 2	Rehearsal	10.17	0.40	15.83	5.38	16.33	9.15
	Pause	10.00	0.00	18.67	9.79	18.67	9.79
	No pause	10.00	0.00	19.17*	7.62	19.33*	7.63
Control 3	Rehearsal	10.00	0.00	15.17	7.80	15.00	8.14
	Pause	10.00	0.00	16.67	7.08	17.33	7.96
	No pause	10.00	0.00	16.17	8.10	16.67	7.84
Anticipators							
Imitation	Rehearsal	10.00	0.00	21.50**	6.94	23.83**	6.55
	Pause	10.17	0.40	24.00**	7.23	24.00**	7.23
	No pause	10.00	0.00	24.17**	4.40	26.67**	2.42
Counterimitation	Rehearsal	10.00	0.00	24.83**	6.67	24.67**	7.47
	Pause	10.33	0.51	20.33*	7.58	20.00**	8.34
	No pause	10.17	0.40	20.83*	8.37	21.67*	8.38
Control 1	Rehearsal	10.00	0.00	18.67*	7.81	19.67*	7.63
	Pause	10.00	0.00	20.67**	5.08	21.17**	5.60
	No pause	10.30	0.51	18.67*	7.99	18.67*	8.11
Control 2	Rehearsal	10.33	0.51	23.50**	5.31	23.83**	5.77
	Pause	10.00	0.00	20.50*	8.21	20.83*	8.56
	No pause	10.17	0.40	18.67	8.98	18.83	8.63
Control 3	Rehearsal	10.17	0.40	18.33*	7.11	19.00*	7.56
	Pause	10.33	0.51	22.33*	8.52	21.83*	8.23
	No pause	10.00	0.00	20.33*	6.50	18.17*	7.02

Table 3

Mean Duration (s) of Eye contact, Mean Number of Lip Movements and Standard Deviation Measured During Conservation Demonstration in Each Pretraining and Rehearsal Condition and for Each Level of Initial Competency

Pretraining	Rehearsal	Eye Contact		Lip Movements	
		M	SD	M	SD
Nonanticipators					
Imitation	Rehearsal	207.33	28.04	17.83	17.45
	Pause	195.00	14.39	0.50	0.55
	No pause	203.33	17.73	0.00	0.00
Counterimitation	Rehearsal	202.50	28.52	3.33	8.16
	Pause	209.67	28.56	0.00	0.00
	No pause	221.00	10.88	0.17	0.41
Control 1	Rehearsal	216.83	6.27	0.17	0.41
	Pause	205.17	15.65	1.33	2.80
	No pause	216.83	31.96	1.00	1.55
Control 2	Rehearsal	175.83	22.95	1.33	1.21
	Pause	197.00	24.70	0.17	0.41
	No pause	195.83	24.77	0.67	1.21
Control 3	Rehearsal	202.17	12.62	9.00	18.41
	Pause	187.00	45.68	0.30	0.82
	No pause	196.83	22.18	0.33	0.52
Anticipators					
Imitation	Rehearsal	211.83	23.95	0.17	0.41
	Pause	196.33	22.09	1.33	1.97
	No pause	195.00	28.45	1.00	2.45
Counterimitation	Rehearsal	199.00	27.76	1.33	1.63
	Pause	202.00	22.96	0.33	0.52
	No pause	213.16	21.16	0.17	0.41
Control 1	Rehearsal	196.83	30.88	2.67	2.88
	Pause	217.00	26.02	0.67	1.21
	No pause	204.33	23.11	0.00	0.00
Control 2	Rehearsal	192.67	7.31	3.17	6.34
	Pause	198.67	46.54	1.83	4.49
	No pause	186.17	29.28	0.50	0.55
Control 3	Rehearsal	193.67	28.29	4.00	3.03
	Pause	219.17	15.11	0.00	0.00
	No pause	201.83	40.51	0.33	0.52